

Helium-4 Experiments near T_{λ} in a Low-Gravity Simulator
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The superfluid transition in ^4He in the presence of a heat current provides an ideal system for the study of phase transitions under non-equilibrium, dynamical conditions. Many physical properties become nonlinear and Q -dependent near the transition. For instance, the enhancement of the heat capacity due to an applied heat current was predicted by the Renormalization-Group (RG) theoretical calculations and has been observed experimentally. Because the isobaric thermal expansion coefficient is a linear function of the specific heat near the transition, both exhibit similar critical behaviors under equilibrium conditions. An enhancement of the thermal expansion coefficient is also expected if a similar relationship exists under non-equilibrium conditions. We report on our experimental search for this enhancement of the thermal expansion. We will explain our results in comparison with the heat capacity results and theories.

We conducted our experiments in the low-gravity simulator facility we developed at JPL. The low- g simulator cancels gravity to about 10 mg in our sample using a magnetic force, therefore allowing us to approach the superfluid transition more closely. Finally, we will describe our recently NASA-funded research project that will further study the effects of a heat current and gravity on the superfluid transition with the application of the SQUID-based High-Resolution Thermometer (HRT) in the low-gravity simulator.

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